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Report 176

Geology of the

Esnagi Lake Area

District of Algoma

By

G.M. Siragusa

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Geological Map

(back pocket)

Map 2382 (coloured)–Esnagi Lake Area,
Algoma District.

Scale, 1:63,360 or 1 inch to 1 mile.

ABSTRACT

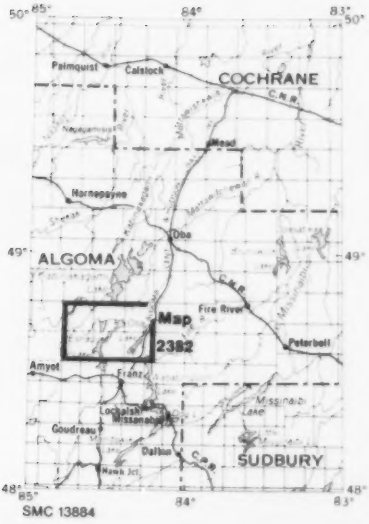

Figure 1–Key map showing the location of the Esnagi Lake Area. Scale 1:3,168,000 or 1 inch to 50 miles.

Parts of Nameigos and Mosambik Townships and minor areas of Cudney and Carney Townships are underlain by an "H"-shaped Early Precambrian belt consisting predominantly of metabasaltic flows locally interbedded with mafic pyroclastic rocks and a few thin felsic metavolcanic units, and, subordinately of clastic metasediments. The supracrustal rocks were metamorphosed under upper-amphibolite to middle-greenschist facies conditions and were uplifted, deformed, and partially assimilated by the emplacement of granodioritic plutons at their margins, and subsequently both the supracrustal and the granitic rocks were intruded by numerous diabase dikes. The main structural feature of the belt is a northeast-trending vertical syncline which underwent axial plane folding about a vertical axis; as a result of this folding a metavolcanic-metasedimentary sequence with a total thickness of about 1830 m (6,000 feet) is twice exposed along a west-northwest line across the north-northeast-trending segment of the belt. Records of old exploration work (1936) indicate that gold is associated with the metavolcanics of the Nameigos-Simpson area. There is no record of exploration work having been done in the north-northeast-trending segment of the belt.

Geology of the Esnagi Lake Area District of Algoma

by

G.M. Siragusa[1]

Introduction

Location and Access

The Esnagi Lake area is in the northern part of the Algoma District and is bounded by Latitudes 48°32′ and 48°47′N and by Longitudes 84°12′00″ and 84°48′00″W. It includes the six contiguous townships of Nameigos, Mosambik, Carney, Doucett, Cudney, and Simpson for a total of approximately 1258 km ^{2} (486 square miles). The area is within the Sault Ste. Marie Mining Division except for Nameigos Township which is within the Thunder Bay Mining Division. Nameigos, Anaharea, Mosambik, Kabiskagami, Esnagi, Oba, and Wabatongushi Lakes are good access points to various parts of the area by float-equipped aircraft; air service is available at White River, approximately 35 km (22 miles) west of the western boundary of the area, and at Wawa, about 61 km (38 miles) south of the southern boundary of the latter. In addition, the Canadian Pacific Railway crosses the Magpie River at the southwestern end of Esnagi Lake in Pearkes Township, approximately 6.4 km (4 miles) south of the area,and the Algoma Central Railway provides access to Simpson Township and the southeastern part of Carney Township. Nameigos Lake, segments of the Nameigos River, and Kabinakagami River provide internal communication routes in the northwestern and western parts of the area; Esnagi Lake, Oba Lake, and segments of the Oba River are useful for the same purpose in the central and eastern parts of the area. Relatively good portages connect North Wejinabikum Lake with Kabiskagami Lake and the latter with Mosambik Lake; Esnagi Lake, the main waterway in the area, can be conveniently reached with a lightweight canoe from Mosambik Lake, via the Magpie River, and this route provides convenient inter-

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nal communications between the central and southern parts of the area.

The map-area is covered at the scale of 1:50,000 or about 1 inch to 4,200 feet by the Oba Lake and Anaharea Lake topographic sheets, at the scale of 1:126,720 or about 1 inch to 2 miles by the Kabinakagami Lake topographic sheet, and at the scale of 1:250,000 or about 1 inch to 4 miles by the White River topographic sheet. ODM-GSC Aeromagnetic Maps 2194G, 2195G, 2208G, and 2209G cover the area at the scale of 1:63,360 or 1 inch to 1 mile.

Physiography

Different physiographic features characterize the northern, west-central, and southern parts of the map-area.

The northern part comprises parts of Nameigos Township, and north-central Mosambik and Carney Townships. Swamps are typical of this area which is flat to gently rolling and has elevations varying mostly between 350 to 381 m (1,150 and 1,250 feet) above sea level. Supracrustal rocks heavily veneered by Pleistocene deposits underlie a strip of land with elevations of 356 to 396 m (1,200 to 1,300 feet) above sea level which extends in easterly direction through northeastern Mosambik and northwestern Carney Townships, and separates the drainage basins of Esnagi and Kabinakagami Lakes. This stretch of relatively high-relief terrain is delimited to the east by several small lakes of subrounded or lobate shape separated by low-relief drift ridges. These lakes are typical landforms in northern Carney Township and form an elongated and broadly northeast-trending system which extends beyond the northern boundary of the map-area, and is the prominent physiographic feature in adjacent Ermine Township. Elevations in excess of 396 m (1,300 feet) are rare in the northern part of the map-area and are restricted to a small hilly area underlain by supracrustal rocks adjacent to, and to the southeast of the prominent north-pointing promontory on the eastern shore of Nameigos Lake; the highest elevation in this area is 257 m (1,500 feet) above sea level.

The main physiographic feature in the west-central part of the map-area is a narrow zone of relatively rugged terrain with mean and maximum elevations of about 396 and 502 m (1,300 and 1,650 feet) above sea level, respectively. This zone extends in a southeasterly direction from the southern shore of Mountain Lake in central Nameigos Township, to the western shore of Esnagi Lake in northern Cudney Township. The outlines of this zone reflect rather closely the structural features and the areal distribution of the supracrustal rocks underlying it. Small rock-rimmed lakes of irregular shape occupy the depressions of the area which, because of this, and because of its relative ruggedness is quite distinct from the terrain in the northern part of the map-area. The physiographic character of this area differs also from that of the rugged terrain in the southern part of the map-area in that it lacks the pattern of intersecting narrow valleys typical of the latter.

The southern part of the map-area includes most of Cudney and Doucett Townships, and western Simpson Township. This is a hilly area underlain by granitic rocks; elevations vary mostly between 396 and 457 m (1,300 and 1,500 feet), and are locally 487 and 533 m (1,600 and 1,750 feet) above sea level. Typi-

cal landforms of this area are many narrow and dominantly northeast-trending valleys which dissect the granitic terrain and control the angular drainage pattern of the area.

Kabinakagami River drains the western part of the map-area; Oba Lake and the Oba River are the main drainage system in the eastern part of it; both the Kabinakagami and Oba Rivers flow to the north. The Mosambik Lake-Magpie River-Esnagi Lake waterway is a third major south-flowing drainage system in the central part of the map-area. Kabinakagami River receives the drainage of several small tributaries and the overflow of Nameigos and Anaharea Lakes via the Nameigos River and Anaharea Creek, respectively. The Oba River channels the overflow of Oba Lake partly into Kabinakagami Lake and partly into the Missinaibi River via the Mattawitchewan River. The Magpie River originates in the central part of the map-area as a minor east-flowing creek draining the overflow of Mosambik Lake into Esnagi Lake; at the exit from Esnagi Lake it flows southward and drains into Lake Superior via the Michipicoten River. The height-of-land separating the Kabinakagami River and the Magpie River watersheds is in the Wejinabikun Lake area of Mosambik Township and is within the physiographic zone previously described with reference to the west-central part of the map-area.

The lakes of the map-area are of three general types: 1) those occupying unfilled parts of swamps in drift-covered areas, 2) those occupying relatively large depressions in drift-covered areas, and 3) those with rock rims. The lakes of the first type are generally about 1.2 km (1 mile) or less in size and are essentially restricted to northern Carney Township and a few localities in the southern part of the map-area. Anaharea Lake in central Doucett Township is the largest lake of the second type; among the lakes of medium and large size it is also the one with the highest elevation above sea level (i.e. 371 m or 1,218 feet). Although this lake is approximately 4.8 km (3 miles) long and 2 km (1.3 miles) wide, bedrock exposures occur only in a few scattered localities on its eastern and northern shores. The rock-rimmed lakes are Oba and Esnagi Lakes, and to a lesser extent, Mosambik and Nameigos Lakes. These lakes have, in the given order, altitudes of 343, 344, 347, and 352 m (1,125, 1,129, 1,138, and 1,154 feet) above sea level, and all of them occupy northeast-trending linear depressions which represent preglacial valleys widened by glacial erosion and locally modified by till deposition. Esnagi, the largest lake in the map-area, is very beautiful and is delimited by steep rocky shores along much of its length; it is approximately 28.8 km (18 miles) long, 402 m (1,320 feet) to 5.6 km (3.5 miles) wide, and is the locus of a major fault. Most of the numerous small lakes scattered throughout the southern part of the map-area occupy segments of narrow valleys originated by erosion along northeast-trending and northwest-trending fractures in the granitic rocks. Some of these lakes occupy segments of two or more interesting fracture-systems and thus exhibit abrupt trend changes in their outlines; a relatively large lake of this type is located in northern Cudney Township about 3.2 km (2 miles) east of Esnagi Lake and is locally known as Star Lake.

Natural Resources

The trees of the map-area are white and black spruce, white birch, jack pine, tamarack, balsam, poplar, and rarely, minor red pine. Spruce and cedar swamps have locally developed along the rivers and at the foot of the rocky high ground. Spruce trees are commonly 10 to 20 cm (4 to 8 inches) in diameter, but may be as much as 30 to 35 cm (12 to 14 inches), and some of their trunks may show prominent abnormal growths of nearly spherical shape. Stands of straight birch and poplar 29 to 35 cm (8 to 14 inches) in diameter were locally seen in drift-covered and gently-rolling ground west of Anaharea Lake. During construction of the railways many jack pine trees were cut to make railroad ties and, subsequently, spruce was used for pulp (Maynard 1929). No evidence of recent logging was seen in the visited parts of the area during the 1973 field season.

The map-area is within the zone of highest moose density in Ontario; moose, rabbit, partridge, bear, and beaver were seen in the summer of 1973 and fox, mink, otter, and muskrat are reported to live in the area. The lakes are populated mostly by pike, pickerel, and white fish, the first being particularly abundant; trout is found in Kabiskagami Lake. Ducks were often encountered along the rivers, and loon is quite common on most lakes throughout the area. Data compiled by the Ministry of Natural Resources (1963) show that the area is within a broad zone of relatively good agricultural potential; the annual snowfall, rainfall, and the average July temperature are 2.5 to 3 m (100 to 120 inches), 0.6 to 0.7 m (25 to 30 inches), and 17 to 18°Celcius (61 to 64°F), respectively. The regional frost hazard is classified as "moderately high".

The natural beauty of the lakes of the area and notably of Esnagi and Oba Lakes, attracts many tourists particularly from the large cities of northern United States. In the summer of 1973 two tourist lodges were operating on Esnagi Lake. In addition individual cabins and/or cottages are found on the shorelines of most of the lakes of medium and large size in the general area, and the movement of tourists and supplies generates considerable air traffic with Wawa and White River during most of the summer.

Previous Geological Work

In 1916, T.L. Tanton (1916) carried out reconnaissance mapping along the Canadian National Railways and adjacent waterways between Gogama and Oba, and visited Kabinakagami Lake, a small part of the southern shore of which is within the present map-area. In 1928 most of Nameigos Township and parts of Mosambik Township were mapped by J.E. Maynard (1929) at the scale of 1:126,720 or 1 inch to 2 miles as part of a geological reconnaissance survey of 12 townships in the general Oba area. Strickland and Cooper Townships, outside, and adjacent to, the western boundary of the present map-area, were mapped by K.G. Fenwick (1967) in 1963 and 1964 as part of a reconnaissance geological survey of 14 townships in the general Dayohessarah Lake area.

Present Geological Work

The 1973 mapping method varied depending upon the lithology, the outcrop density, and the aeromagnetic relief in different parts of the map-area.

The terrain underlain by supracrustal rocks was covered mostly by pace-and-compass bush-traverses at intervals of approximately half mile (800 m) or less, where this was warranted by sufficient outcrop density; unfortunately lake-shore exposures of supracrustal rocks are scarce. In planning of tie-lines among outcrop areas, the criteria were the size, the expected quality of exposure, and the aeromagnetic expression of the latter.

Areas peripheral to the metavolcanic-metasedimentary belts, showing aeromagnetic expressions which departed in shape, trend, or both, from those considered typical of diabase dikes, and areas where the estimated probability of finding outcrops was low were covered by reconnaissance traverses.

Areas of problematic access and where only granitic rocks were expected to be present were covered by helicopter reconnaissance runs at 2.4 to 3.2 km (1.5 to 2 miles) intervals.

Acetates overlain on air photographs supplied by the Air Photo Library of the Ministry of Natural Resources, at the scale of 1 inch to ¼ mile (or, approximately 1 cm to 158 m)flown in 1961 were used to record geological data which were then transferred to a 1 inch to ¼ mile base map supplied by the Cartographic Section of the Surveys and Mapping Branch, Ontario Division of Lands. The small size of the openings in the forest and/or the rugged conditions of the terrain at, or close to, the sites of bedrock exposures were limiting factors in helicopter mapping. Where the ground conditions did not permit landing, but the rocks could be examined at hovering distance, they were coded with the symbol of the pertinent unsubdivided rock-unit.

Acknowledgments

Assistance in the 1973 field season was provided by B. Gibbs as senior assistant, and M. Spazier, B. Eggertson, and B. Meyer as junior assistants; B. Gibbs carried out independent mapping in various localities of the map-area. The help offered by Ivan Maclachlan of Camp 88 (Esnagi Lake, Pearkes Township) in facilitating helicopter operation, equipment repairs, and communications is gratefully acknowledged.

GENERAL GEOLOGY

Parts of Nameigos and Mosambik Townships and minor areas of Cudney and Carney Townships are underlain by an Early Precambrian belt consisting dominantly of metamorphosed mafic flows locally interbedded with pyroclastic units and a few thin felsic metavolcanic units, and, subordinately, of clastic metasediments. The supracrustal rocks were strongly deformed, metamorphosed under upper amphibolite and middle greenschist facies conditions (Fyfe, Turner,

and Verhoogen 1962), intruded and partly assimilated by granitic rocks, and, subsequently both the supracrustal and the granitic rocks were intruded by numerous diabase dikes.

The metavolcanic-metasedimentary belt has an unusual 'H-like' shape being formed by two major northwest-trending segments jointed at their midpoints by a relatively short and wide segment trending northeast. For descriptive purposes the two northwest-trending segments and the northeast-trending segment of the belt are hereafter referred to as the northern, the southern, and the central belts, respectively.

The northern belt extends for approximately 24 km (15 miles) from the eastern shore of Nameigos Lake in Nameigos Township to western Carney Township. Although this belt is very poorly exposed being covered by extensive Pleistocene deposits particularly toward the east, it is suggested that it is the largest in the map-area, and that in eastern Mosambik Township it probably exceeds 4.8 km (3 miles) in width. Granitic rocks are thought to underlie an area of about 14.8 km ^{2} (5.7 square miles) in the central zone of this belt (see Geological Map, back pocket); no outcrop exposures were found by helicopter reconnaissance of this area; and two outcrop areas seen from the air close to the southern margin of the area could not be reached by ordinary bush traverse. Consequently the inference of the lithology in this area is based entirely on interpretation of geophysical data; these show that the area corresponds to aeromagnetic total-field values of 59,980 to 59,990 gammas (ODM-GSC 1963b) whereas the values corresponding to mafic volcanics and mafic intrusive rocks in the general area vary mostly between 60,100 and 60,200 gammas and locally exceed 60,500 gammas. However, since in the map-area the clastic metasedimentary rocks and the felsic intrusive rocks are generally undistinguishable on the basis of aeromagnetic pattern and/or relief, some metasedimentary rocks may be present in the area shown as granitic in the central zone of the northern belt. The metavolcanics of the northern belt extend to the north of the present map-area into the adjacent townships of Breckenridge and Lizar (Siragusa 1975); to the east they are probably in fault-contact with the granitic rocks at a locality about 4.8 km (3 miles) north and 2.4 km (1.5 miles) east of the northern shore of Esnagi Lake in Carney Township. This is suggested by 1) aeromagnetic data (ODM-GSC 1963c,d), and 2) by the fault-contact relationships found at the eastern end of the southern belt (referred to further on).

The southern belt parallels the northern belt and extends 5.6 to 8 km (3.5 to 5 miles) south of the latter, from a locality in eastern Strickland Township approximately 1400 m (4,600 feet) west of the western boundary of the map-area (Fenwick 1967) to the western shore of Esnagi Lake in northern Cudney Township. This belt is moderately to locally well exposed and its length and width within the map-area are 24.6 km (14.5 miles), and 0.4 to 2.2 km (0.25 to 1.5 miles), respectively. Along the western shore of Esnagi Lake in northern Cudney Township the belt has a thickness of about 1.5 km (4,900 feet); facing the metavolcanics of the western shore and at a distance of 243 to 426 m (800 to 1,400 feet) from them along strike are exposures of pegmatitic quartz monzonite. This abrupt truncation of the metavolcanics indicates that Esnagi Lake is the locus of a major northeast-trending fault which, as previously suggested, probably truncates also the eastern end of the northern belt. Fault-contact relationships are also present in the Joselin Lake area on the western side of the belt.

TABLE 1 TABLE OF LITHOLOGIC UNITS FOR THE ESNAGI LAKE AREA.

CENOZOIC

QUATERNARY

PLEISTOCENE & RECENT

Silty and sandy till; fluvioglacial sand and gravel (eskers); glaciolacustrine clay, silt, and sand; fluvial, lacustrine, and swamp deposits; sand, silt, clay.

Unconformity

PRECAMBRIAN

MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)

MAFIC INTRUSIVE ROCKS

Diabase dikes; porphyritic diabase dikes.

Intrusive Contact

EARLY PRECAMBRIAN (ARCHEAN)

FELSIC INTRUSIVE AND METAMORPHIC ROCKS

Biotite trondhjemite, hornblende-biotite trondhjemite, biotite-hornblende trondhjemite and associated dioritic rocks derived from contamination; biotite granodiorite, trondhjemite, leucocratic quartz monzonite, minor muscovite-bearing quartz monzonite.

Intrusive Contact

METASEDIMENTS

Conglomerate, sandstone, and paragneiss derived mostly from reworking of volcanics; lesser conglomerate derived from reworking of sedimenatry and early granitic rocks; garnetiferous metasediments.

Iron Formation

METAVOLCANICS

Dominant basalt and associated mafic pyroclastic rocks; minor felsic and ultramafic metavolcanics; migmatite, amphibolite.

The central belt is well exposed in an area of approximately 25.8 km^2 (10 square miles) half of which is in western Mosambik Township and the other half is in the eastern Nameigos Township; the main structure of the area is a northeast-trending vertical syncline which underwent axial plane folding about a vertical axis (see "Structural Geology" section). The whole stratigraphic thickness of the volcanic-sedimentary series is exposed across the eastern limb of the northeast-trending segment of the syncline, and is about 1830 m (6,000 feet). An agglomeratic unit occurs within the series and is partially exposed along the southern shore of North Wejinabikum Lake (Mosambik Township), where it has a thickness of about 365 m (1,200 feet). This unit has undergone variably severe deformation and stretching and was traced for approximately 4.8 km (3 miles) north and 4 km (2.5 miles) south of North Wejinabikun Lake. Westward, or up sequence, the agglomerate grades into a lighter coloured clastic rock in which limited evidence of reworking of the coarse fraction is present and suggests a sedimentary origin. Owing to deformation, similarity between the matrix components, and scarcity of lakeshore exposures, the distinction between meta-agglomerate and metaconglomerate is often problematic. The conglomeratic unit has a probable maximum thickness of 518 m (1,700 feet) and was traced for approximately 6.4 km (4 miles) to the south and west of North Wejinabikun Lake; in this area the central belt joins the southern belt and, accordingly, the trend of both the volcanic and the sedimentary clastic units changes progressively from north-northeast to west-northwest.

Minor elongated bodies and disrupted bands of mafic metavolcanics trending north-northeast and surrounded by granitic rocks occur in Mosambik Township in the area between Mosambik Lake and the eastern boundary of the central belt; a northwest-trending narrow band of this type is also found in the Anaharea Lake area of Doucett Township.

The metasedimentary rocks include conglomerate, sandstone, and paragneiss, and appear to be of local derivation, the principal source of clasts being the metavolcanics of the area.

The granitic rocks include different types among which biotite granodiorite, and pegmatitic quartz monzonite are most common. The latter being a younger phase contains inclusions of the former.

Biotite trondhjemite and hornblende biotite trondhjemite occur at the margins of the metavolcanics, largely as concordant sheets within the latter (e.g. Kabiskagami Lake area), and these sheets are regarded as syntectonic intrusions (see "Time and space relationships of granitic rocks" section).

The granitic and the supracrustal rocks are cut by diabase dikes trending dominantly northwest, and, subordinately, northeast. The diabase dikes commonly form the hilltops of high-ground areas, are much more numerous than it could be shown on the map, are locally porphyritic, and almost invariably contain traces of pyrite.

Early Precambrian (Archean)

METAVOLCANICS

Mafic to Intermediate Metavolcanics

Mafic to intermediate metavolcanics are the dominant extrusive rock type, are green to dark green in colour, weather to grey and grey-green hues, are mostly fine grained but may be medium to coarse grained, contain quartz veins and quartz pods of irregular shape which can be locally abundant, are almost invariably foliated, and were regionally metamorphosed under upper amphibolite to middle greenschist facies conditions. Examinations of 31 thin sections shows that mineralogically and in order of decreasing abundance these rocks consist of hornblende, andesine, oligoclase, albitic plagioclase, epidote, and quartz. The accessory minerals are one or more among carbonate, microcline, biotite, chlorite, penninite, anthophyllite, hematite, leucoxene, zircon (in biotite or hornblende), and pyrite.

Clinopyroxene relics are of rare occcurrence. Hornblende accounts for 50 to 70 percent of the composition of the mafic to intermediate metavolcanics regardless of their fabric and grain size. It has pleochroic colours ranging from light green and tan to intense green and has two general modes of occurrence, i,e. 1) as euhedral strongly pleochroic equigranular crystals which are elongated or prismatic in habit, subparallel in fabric, and are uniformily distributed throughout the rock, and 2) as irregularly shaped patchy aggregates of grains which are heterogeneous in shape, size, and orientation. In the fine-grained metavolcanics the size of the individual hornblende crystals generally ranges from 0.09 to 0.18 mm. Part of the amphibole clustered in the aggregate may show noticeably less dichroism than does the amphibole of prismatic habit. The patchy aggregate texture is more common than the prismatic texture and it is suggested that it indicates a slight shift of metamorphism toward higher rank conditions; by further increase in metamorphic rank the heterogeneous aggregates give place to euhedral hornblende phenocrysts of large size found in the coarse-grained mafic metavolcanics described further on. Hornblende commonly shows segregations of iron oxides and only rarely is seen to be pseudomorphous after clinopyroxene. Plagioclase is andesine (An_{33-47}) to oligoclase (An_{14-22}) in the amphibolite grade rocks and is albitic in the greenschist grade rocks ; the former conditions are largely predominant over the latter. The amounts of plagioclase and quartz vary between 15 and 40 percent and 3 to 12 percent, respectively. Both these minerals occur essentially as groundmass components although plagioclase may also be present as variably altered phenocrysts, and quartz (together with epidote) as secondary fracture-filling material. The fine-grained mafic metavolcanics locally grade into medium- and coarse-grained dark green rocks in which foliation is either poorly developed or absent. Equigranular texture with grain size of 2 to 4 mm and up to 6 and 7 mm is commonly seen in these rocks which, in the field, might be interpreted as metamorphosed inner parts of thick lava flows. In nine

thin sections these rocks show a porphyritic texture which is very seldom detectable in hand specimen. The porphyritic texture results from large euhedral hornblende phenocrysts separated by fine-grained interstitial and recrystallized feldspar and quartz. Minute poikilitic inclusions of feldspar and quartz occur within the hornblende phenocrysts, and this together with the euhedral habit and freshness of the amphibole, indicate that the phenocrysts are porphyroblasts derived from metamorphic growth.

The only evidence of primary structures in the nonclastic metavolcanics consists of flattened small pillows generally unsuitable for top determinations, found at a few localities of the central belt.

AGGLOMERATE

Layers of mafic to intermediate agglomerate interbedded with subordinate nonclastic flows of intermediate composition and minor felsic metavolcanic units, are discontinuously exposed along the central segment of the southern shore of North Wejinabikun Lake (Mosambik Township). These rocks form a sequence 365 m (1200 feet) thick which strikes north-northeast, dips to the west, and was traced north and south of the lake (see "General Geology" section). This sequence is bounded on the east by fine-grained mafic metavolcanics with minor felsic metavolcanic and tuffaceous interbeds exposed at the southeast end of the lake, and to the west by conglomerate exposed at the southwest end of the lake. The agglomerate was deformed by flattening (Photo 1), and as a result of deformation and recrystallization the boundaries between the rims of some of the clasts and the surrounding matrix are not sharp. The matrix is a fine-grained, greyish green, and strongly foliated mafic rock; two thin sections show that approximately half of the volume of the matrix consists of elongated aggregates of subhedral hornblende containing 6 percent biotite with traces of zircon and iron oxides. Hornblende and biotite possess strong preferred orientation. The remainder of the matrix is a fine-grained recrystallized groundmass of untwinned feldspars containing about 8 percent quartz. Within the felsic groundmass are relatively large aggregates of cloudy alteration products and cryptocrystalline epidote. These aggregates have an ovoid outline and show recognizable fragmental "tails" at their interface with the groundmass. These characteristics suggest that the ovoid aggregates are altered feldspathic porphyroclasts the shape of which resulted from shearing during deformation, and the identity of which was not completely obliterated by the recrystallization that accompanied or followed deformation.

The clasts in the eastern half of the agglomeratic sequence are quite uniform in composition. They represent 30 to 60 percent in volume of the rock, are lensoid in shape, and their sections normal to bedding are mostly 10 to 50 cm (4 to 20 inches) long with width to length ratios of ⅓ to ¼. They consist of a fine-grained, medium green mafic rock which is porphyritic owing to the presence of 30 to 50 percent dull white feldspar phenocrysts up to 3.8 cm (1.5 inches) in size, and of 3 to 4 percent hornblende nodules about 0.6 cm (0.25 inch) in diameter. The fine-grained groundmass of the clasts and the matrix of the agglomerate are similar in composition but the clasts are more felsic because of the abundant

OGS9774

Photo 1–Mafic agglomerate; stretched clasts of porphyritic intermediate metavolcanics in mafic matrix. Matrix and clasts are both metamorphosed crystal tuff. North Wejinabikun Lake, Mosambik Township.

OGS9775

Photo 2–Agglomerate with stretched clasts of aphanitic felsic metavolcanics in mafic matrix. North Wejinabikun Lake, west of agglomerate shown in Photo 1.

feldspathic phenocrysts within them. A thin section of the groundmass of one clast shows that it contains about the same amount of hornblende as the matrix of the agglomerate, but does not have biotite, and has an additional 4 percent quartz in the form of tiny lenses and veinlets generally parallel to the foliation defined by the hornblende fabric. The ovoid feldspathic porphyroclasts are also present, and the hornblende nodules have resulted from complete replacement of some of the porphyroclasts by pseudomorphous fresh hornblende. The composition of the large tabular feldspathic phenocrysts could not be determined in the available thin sections because of the intensity of the alteration affecting them; they are probably a rather calcic plagioclase.

The foregoing descriptions refer to the eastern part of the agglomeratic sequence where the clasts and the matrix of the agglomerate are apparently the metamorphic derivatives of crystal tuffs of intermediate and mafic composition, respectively. In the western part of the sequence the composition of the clasts is less uniform and locally felsic. The overall size of the clasts is considerably smaller than to the east (compare Photos 1 and 2). This suggests that the tops are west.

VOLCANIC BRECCIA

Minor occurrences of a rock which is probably a metamorphosed volcanic breccia were noted in a cursory visit of the small lake located in Nameigos Township 3505 m (11,500 feet) north and 1920 m (6,300 feet) west of the southwest corner of Mosambik Township; the area of the lake is underlain dominantly by conglomerate the coarse fraction of which is volcanic (see "Metasediments" section) At one locality of the western shore the breccia consists of angular to subangular volcanic fragments, dominantly intermediate and subordinately mafic in composition, embedded in a mafic matrix. The fragments range in size from less than 2.5 cm (1 inch) to about 15 cm (6 inches) and account for about 50 percent in volume of the rock. The mafic fragments are epidotized to variable extent and contain 2 to 3 percent hornblende phenocrysts up to 1.2 cm (0.5 inch) in size. At another locality on the east shore of the lake three thin layers of breccia similar to the one just described form a unit 1.8 m (6 feet) thick which strikes west-northwest and dips almost vertically; in all three of the layers the fragments of relatively large size are slightly predominant on the north side and this limited evidence suggests that tops are south.

Ultramafic Metavolcanics

An outcrop of ultramafic metavolcanics was found approximately 365 m (1,200 feet) southwest of the eastern tip of the lake which is connected to, and just to the east of, Mountain Lake in Nameigos Township. The ultramafic metavolcanics occur within the lower stratigraphic section of the northwest-trending and south-dipping mafic metavolcanic sequence in the western half of the southern belt. Owing to discontinuous outcrop distribution the thickness of the ultramafic

OGS9776

Photo 3–Thin felsic metavolcanic layers (at top of and below hammer) interbedded with mafic metavolcanics. Central belt, Western Mosambik Township.

flow is not known but may vary between a minimum of 4.5 m (15 feet) and a maximum of about 91 m (300 feet). The rock is dense, aphanitic, dark green to nearly black on fresh surface, and weathers to a mat white colour which hardly penetrates the rock for more than a few millimetres. A thin section of this rock shows that it consists of fibro-lamellar aggregates of antigorite and tremolite-actinolite. Segregations of iron-titanium oxides (ilmenite?) account for about 12 percent in volume of the rock and form subparallel thin stringers which define a foliation. Sample 16, Table 3 represents a chemical analysis of this rock.

Felsic Metavolcanics

Felsic metavolcanics are quite scarce and include fine-grained to aphanitic rocks, and minor felsic tuff.

FINE-GRAINED TO APHANITIC FELSIC METAVOLCANICS

These occur essentially as thin interbeds within mafic metavolcanics (Photo 3), and subordinately as coarse-fraction component of clastic metasediments and agglomerate. The interbeds are commonly 8 to 10 cm (a few inches) to less than 50 cm (2 feet) thick, and in the present map-area they are less common than in

the adjacent Kabinakagami Lake area. The rock is fine grained to aphanitic in texture, white, light grey to light tan, and weathers mostly to white but may be mottled by light green or light pink hues. It may be porphyritic owing to the presence of ellipsoidal or nearly spherical inclusions of opalescent quartz ranging in size from 1.5 to 6.3 mm (0.06 to 0.25 inch). Three thin sections of this rock show that it consists of a recrystallized aggregate of oligoclase (An_{18-20}), microcline, quartz, and muscovite, with subordinate amounts of biotite, chlorite, and epidote (replacing feldspars), and traces of hematite and zircon (in biotite). The groundmass is dominantly feldspathic (oligoclase being possibly more than microcline), contains 12 to 20 percent quartz, and has grain size of 0.03 to 0.05 mm. Biotite is partially replaced by chlorite, accounts for 1 to 3 percent in volume of the rock, and normally occurs as lamellar aggregates larger than the average groundmass grains; in one thin section it was seen to occur as unusually large subhedral tabulae with weak dichroism, poorly defined cleavage traces, and very small axial angle ($2V \cong 0°\text{-}3°$). Muscovite occurs mostly as microlites 0.01 to 0.008 mm wide and about 0.07 mm long. These are uniformly distributed throughout the groundmass and may represent up to 8 percent in volume of the rock.

FELSIC TUFF

Layers of metamorphosed interflow felsic tuff generally 5 to 12 cm (2 to 5 inches) thick but may be up to 45 cm (18 inches) thick, were seen interbedded with the mafic volcanics at a few localities of the North Wejinabikun Lake area. The rock consists of a light grey to light tan, fine-grained, matrix containing 20 to 50 percent tiny fragments of aphanitic felsic metavolcanics which have been flattened and stretched to variable extent. Although some evidence of uneven distribution of clast sizes can be present across these beds, it is generally undecisive for the purpose of top determination.

Chemical Composition

Whole rock chemical analyses of eight samples of mafic metavolcanics are shown in Table 3. Samples 11 to 15, 17, and 18 represent typical fine- to medium-grained green and green-grey metavolcanics which do not show evidence of alteration and/or mineralization. Sample 16 is an aphanitic dark coloured ultramafic metavolcanic (see "Ultramafic Metavolcanics" subsection). The chemical data were used as input data in a computer program developed by T.N. Irvine and W.R.A. Baragar (1971) and currently used by the Mineral Research Branch of the Ontario Division of Mines. The program is useful in that it provides a basis for the comparison of chemical trends in the metavolcanics and relates nomenclature to chemical composition. The open circles numbered 1 to 10 in the diagrams of Figures 3, 4, and 5 represent metavolcanics from the Kabinakagami Lake area (Table 2) and the solid dots numbered 11 to 18 are metavolcanics from the Esnagi Lake map-area. Except for plots 8 to 10 which represent felsic vol-

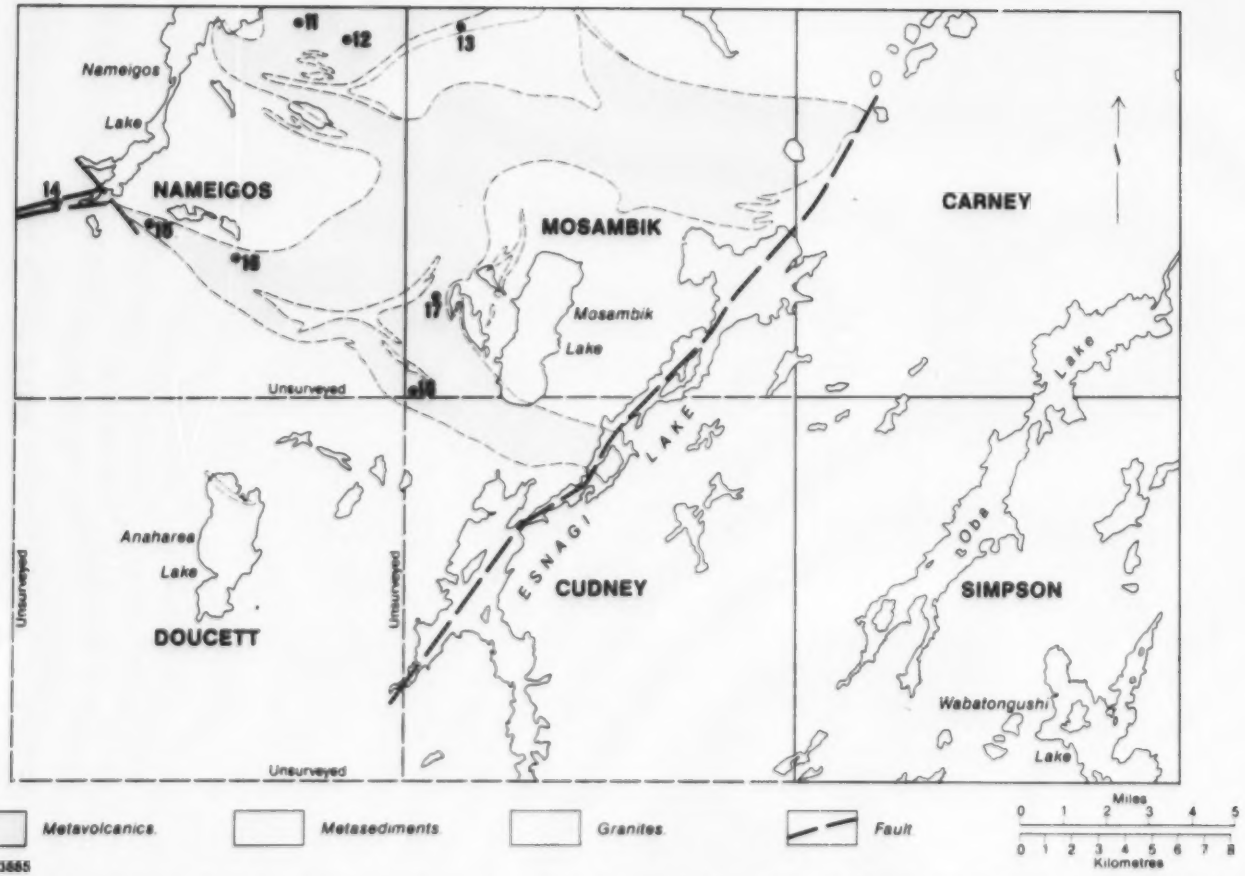

Figure 2–Location of chemically analyzed metavolcanic samples 11 to 18. Sample 13 is from the small band of metavolcanics interbedded with metasediments in northwestern Mosambik Township.

TABLE 2 WHOLE ROCK CHEMICAL ANALYSES OF TYPICAL METAVOLCANICS. (ANALYSES BY MINERAL RESEARCH BRANCH, ONTARIO MINISTRY OF NATURAL RESOURCES, DIVISION OF MINES).[1]

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	S	MnO	CO_2	H_2O^+	H_2O^-	TOTAL
1	48.60	12.30	2.02	9.75	8.89	12.60	1.62	0.10	0.93	0.06	0.01	0.23	0.25	1.81	0.91	100.08
2	50.20	14.60	2.38	13.60	2.67	8.25	2.72	0.46	1.71	0.14	0.05	0.37	0.10	1.54	0.23	99.02
3	49.40	14.50	1.60	9.35	9.81	9.30	2.40	0.29	0.73	0.06	0.01	0.20	0.10	1.47	0.22	99.44
4	53.20	15.00	1.42	9.75	5.50	9.88	1.98	0.31	1.10	0.13	0.01	0.32	0.15	0.87	0.16	99.78
5	50.20	13.70	1.50	9.00	9.20	11.00	1.87	0.07	0.77	0.07	0.01	0.20	1.10	1.10	0.14	99.93
6	47.80	10.70	1.85	8.85	16.20	11.10	1.16	0.07	0.52	0.04	0.01	2.25	0.10	1.88	0.13	102.66
7	49.20	14.60	1.75	9.50	7.65	12.00	1.64	0.13	0.98	0.10	0.06	0.21	0.10	1.11	0.10	99.13
8	74.00	14.60	0.44	1.11	0.10	2.27	6.04	0.48	0.16	0.05	0.02	0.03	0.10	0.53	0.09	100.02
9	73.20	16.30	1.17	0.29	0.45	0.39	1.75	3.88	0.27	0.06	0.41	0.02	0.05	1.66	0.11	100.01
10	70.60	15.20	0.73	1.40	0.91	2.90	3.88	2.58	0.24	0.07	0.31	0.05	0.85	0.91	0.10	100.73

Samples 1 to 7 are mafic metavolcanics from Derry Township, and samples 8 to 10 are felsic metavolcanic interbeds from Lizar Township.

[1]This table is reproduced from G.M. Siragusa, "The Geology of Kabinakagami Lake Area"; Ontario Div. Mines GR159, Table 2, p.12.

TABLE 3 | WHOLE ROCK CHEMICAL ANALYSES OF TYPICAL METAVOLCANICS. (ANALYSES BY MINERAL RESEARCH BRANCH, ONTARIO MINISTRY OF NATURAL RESOURCES, DIVISION OF MINES).

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	S	MnO	CO_2	H_2O^+	H_2O^-	TOTAL
11	47.40	12.50	4.20	12.90	5.80	8.60	2.26	0.29	1.68	0.11	0.03	0.29	0.12	2.47	0.16	98.81
12	49.80	17.10	1.52	7.98	7.00	10.50	2.26	0.97	1.02	0.09	0.02	0.26	0.06	1.54	0.21	100.03
13	51.70	12.80	2.57	6.95	10.30	9.85	2.70	1.16	0.96	0.24	0.03	0.20	0.13	1.32	0.21	101.12
14	49.40	13.30	3.05	9.24	8.79	11.20	2.48	0.51	0.90	0.07	0.02	0.24	0.10	1.18	0.13	100.61
15	45.10	16.70	1.80	9.97	10.20	11.20	2.24	1.04	0.70	0.05	0.01	0.29	0.10	1.40	0.13	100.93
16	45.10	11.10	1.80	9.45	17.40	9.42	1.70	0.19	0.62	0.05	0.01	0.22	0.10	3.44	0.11	100.71
17	53.60	13.50	3.48	10.90	3.90	7.88	3.32	0.65	1.08	0.16	0.14	0.26	0.13	1.17	0.10	100.27
18	51.70	16.60	1.86	6.42	7.82	10.40	2.97	0.58	0.34	0.08	0.03	0.17	0.10	1.28	0.13	100.48

Samples 11 to 13 are from the northern belt; sample 17 is from the central belt; the remaining samples are from the southern belt. Sample 15 is the alkaline basalt described on page 35, and sample 16 is the ultramafic rock described on page 25.

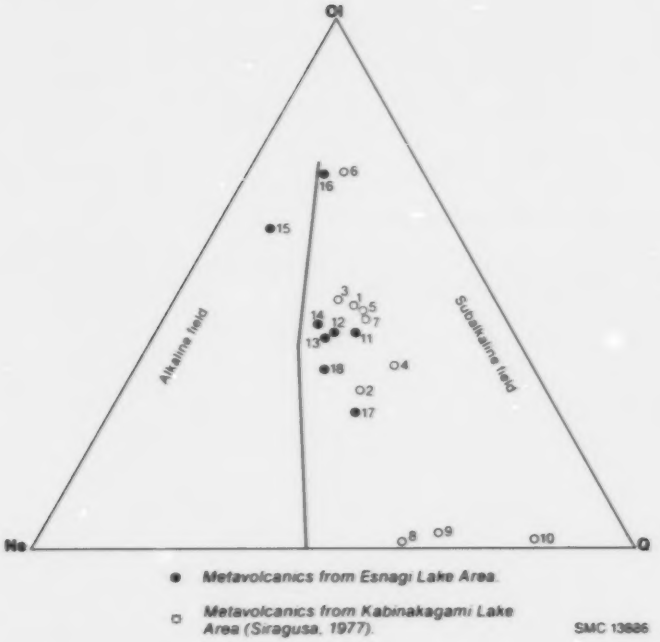

Figure 3–Plots of normative nepheline-quartz-olivine ratios on the face of the tetrahedron representing the clinopyroxene-olivine-nepheline-quartz system. The line separating the alkaline and subalkaline fields is that proposed by Irvine and Baragar (1971).

canic interbeds, all the other plots represent rocks which in the field were mapped as "mafic to intermediate" mainly on the basis of small variations in colour index. Figure 3 shows that all but one of the analyzed volcanics are subalkaline and Figure 4 shows that most subalkaline rocks are tholeiitic. Sample 15, the alkaline rock, is a fine-grained, thoroughly recrystallized, foliated rock consisting almost entirely of hornblende, and is the metamorphic equivalent of a potassic alkali basalt. If the subdivision of the subalkaline rocks is made on a plot of Al_2O_3 versus normative plagioclase composition, as suggested by Irvine and Baragar (1971, p.36) for rocks in the basaltic range, the results are, in the present situation, virtually identical with those obtained by the AFM diagram of Figure 4. The AFM diagram is preferred by the present writer in that it shows that the analyzed mafic rocks 1) have a relatively uniform alkali content and a significant spread in the magnesium and iron content, and 2) plot in the same area of the AFM diagram as the tholeiitic suites of Hawaii and Coppermine River (compare Figure 4 in the present report with Figures 2A and 2B of Irvine and Baragar 1971, p.528). The plot of the normative plagioclase composition versus normative colour index (Figure 5) shows the apparent scarcity of rocks of intermediate composition. Although these chemical data are few in number they could reflect a true gap in the compositional range of the volcanic rocks present in the map-

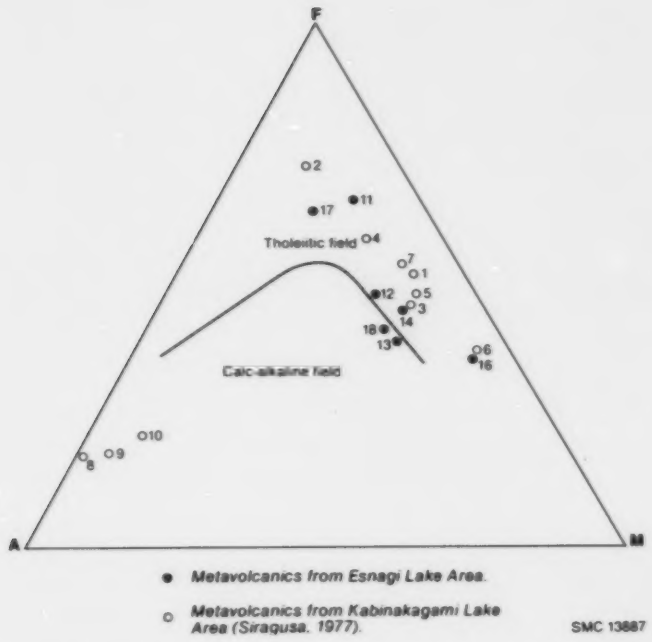

Figure 4–AFM plots of metavolcanics, (after Irvine and Barager 1971). Sample 15 is not shown; it is not a subalkaline volcanic.

area. The phenomenon exists in many volcanic areas throughout the world and has been dealt with by several workers (Yoder 1973). The northern belt of the present map-area extends into the Kabinakagami Lake area mapped by the writer in 1972. Chemical analyses of Samples 1 to 10 are reproduced in Table 2 of this report (Siragusa 1977, Table 2).

Contact Relationships with the Granitic Rocks

Throughout the map-area the contacts of the metavolcanics with the granitic rocks are generally unexposed. At a few localities along the southern boundary of the southern belt the contact is exposed and is characterized by sharp discordant intrusive relationships; apart from epidotization which may be present and can be locally abundant, no significant mineralogical change or deformation was brought about in the metavolcanics by the intrusive rocks. The granitic rock is massive, and thus represents a posttectonic intrusion, and is potassic being generally a medium-grained to pegmatitic quartz monzonite. In the Magpie

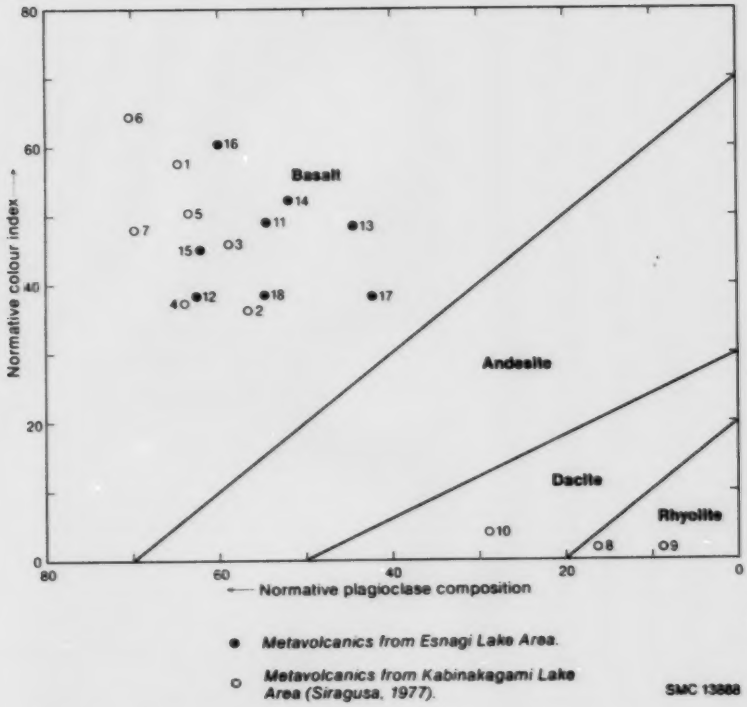

Figure 5–Compositional range of metavolcanics (after Irvine and Barager 1971).

River-Esnagi Lake area and west of Mosambik Lake the contacts are relatively well exposed and are dominantly migmatitic[1].

The rocks in the migmatitic contact zone marginal to the southeast edge of the northern belt show a variety of textural and compositional features. A common type is characterized by overall parallelism of the foliation in the volcanic xenoliths to the gneissosity in the migmatitic neosome, and to the fabric of the xenoliths within the latter (Photo 5). The migmatitic neosome although contaminated to variable extent by assimilation of volcanic rock appears to be essentially trondhjemitic in composition. In some outcrops one can see that areas of the neosome of suitable composition became quite mobile at the metamorphic conditions under which the migmatite originated, and thus became capable of

[1]Migmatite is a mixed rock in which fragments (or xenoliths) of old country rock (paleosome) are embedded in a younger rock (neosome) of intrusive or metamorphic origin.

OGS9777

Photo 4–Partially assimilated hornblende-rich xenolith (dark rock on left) within trondhjemite (light rock on right) cut by vein 25 cm (10 inches) thick of pegmatitic quartz monzonite. Note large potassic feldspar crystals close to margins of pegmatitic vein. Small island on west side of Kabinakagami Lake, northeast of Esnagi Lake area.

OGS9778

Photo 5–Slightly deformed concordant metavolcanic xenoliths (dark rock) in trondhjemitic neosome. Eastern Mosambik Township.

OGS9779

Photo 6–Migmatite deformed metavolcanic xenoliths (dark rock) in trondhjemitic neosome. Note veinlets of remobilized neosome cutting across foliated fabric of rock. Eastern Mosambik Township.

"re-intruding" the rock across foliation (Photo 6 and 7). Agmatitic migmatite, although less common, is also present. It may contain blocks of one individual rock (Photo 8), or of an older migmatite (Photo 9); blocks of migmatitic granodiorite up to 4.5 m (15 feet) in size can occur as paleosome of agmatitic migmatite with quartz monzonite neosome. In general, the complexity of the migmatites tends to increase with the distance from the volcanics; variably deformed and assimilated hornblende xenoliths in a gneissic trondhjemitic neosome are found close to the volcanics, whereas migmatitic trondhjemite and granodiorite with hornblende and/or biotite-rich xenoliths occur as paleosomes of migmatites

OGS9780

Photo 7–Migmatite detail from outcrop area of Photo 6.

at some distance from the volcanics. The neosome of the complex multiphase granitic migmatites is generally coarse-grained quartz monzonite. West of Mosambik Lake large metavolcanic xenoliths occur as disrupted elongated bodies parallel to the central belt. The contact relationships at the boundary of the belt proper are characterized by concordant intrusions of syntectonic trondhjemite sheets. One of these is well exposed at the base of the thin volcanic series underlying the promontory on the south side of Kabiskagami Lake (Mosambik Township). These trondhjemitic intrusions as well as the metavolcanics which host them are commonly cut by dikes of potassic granite (Photo 10).

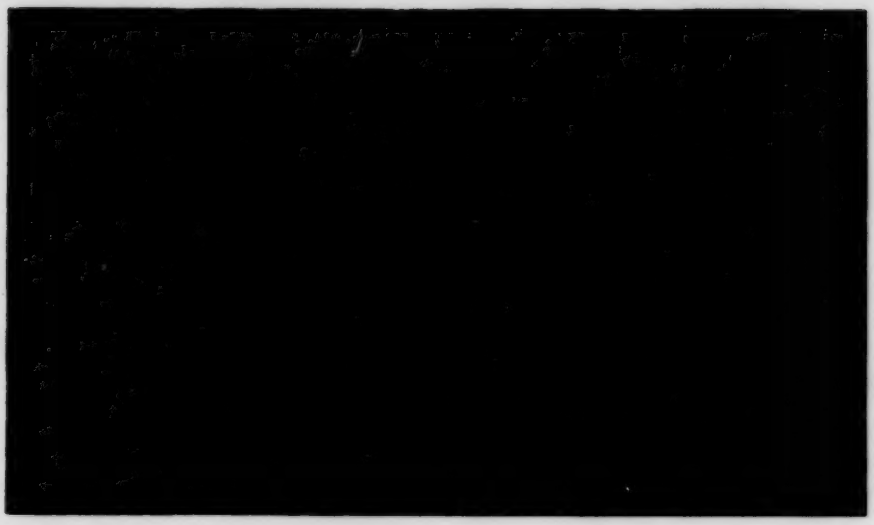

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Photo 8–Agmatitic migmatite, angular metavolcanic xenolith (dark rock) in quartz monzonitic neosome. Prominent xenolith in centre upper part of photo is about 46 cm (18 inches) long; lighter coloured fragment (right-hand side margin) is partially assimilated. Western Carney Township.

OGS9782

Photo 9–Agmatitic migmatite, white rock is quartz monzonite; most of the angular blocks are granodiorite. The prominent triangular block in the left half of the photo is about 1 m (3 feet) long and consists of granodiorite containing nearly completely assimilated mafic metavolcanic xenolith (apical area of obtuse angle). Western Carney Township.

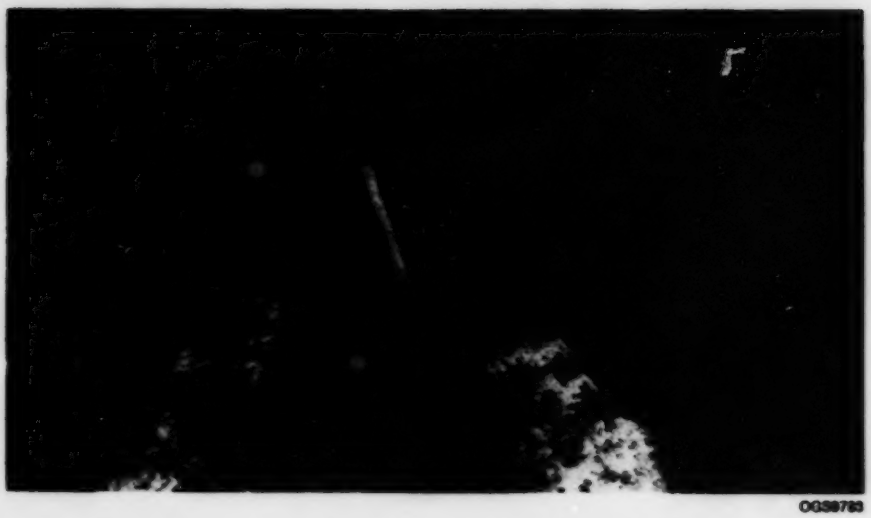

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Photo 10–Concordant trondhjemitic sill (light rock parallel to long edge of photo) intruded into mafic metavolcanics (dark rock) cut by quartz monzonite dikelets (white rock). Eastern Mosambik Township.

METASEDIMENTS

Dominant conglomerate and lesser sandstone and paragneiss are interbedded with the metavolcanics of the central and southern belts; minor lean sulphide-facies iron formation bands are locally interbedded with the metavolcanics of the northern belt. Metasediments which are probably dominantly conglomerate and subordinate sandstone, underlie the area along the northern margin of the assumed granitic body at the centre of the northern belt. Because of the scarcity of outcrops in the northern belt the geological boundaries shown in this area are based largely on interpretation.

Conglomerate

CENTRAL AND SOUTHERN BELTS

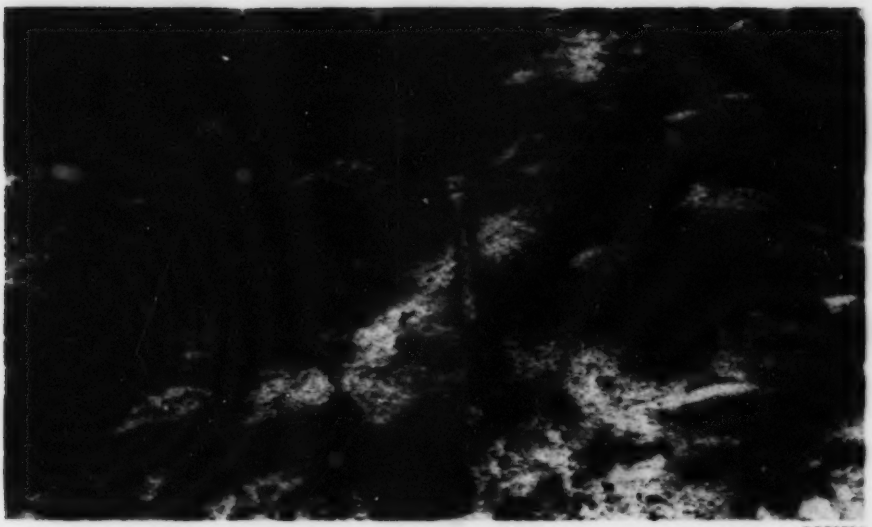
In the central and southern belts this rock consists of a grey-green to tan and occasionally light brown sandstone containing 15 to 20 percent and up to 40 percent subangular to ovoidal metavolcanic pebbles, which are mostly interme-

diate to mafic but may be felsic in composition, and range in size from 0.6 to 15 cm (0.25 to 6 inches). This rock has been deformed to variable extent by flattening parallel to bedding, and because of this its distinction from volcanics of mafic and intermediate composition is generally problematic particularly in bush traverses; in lakeshore exposures the lighter tones of the weathered rock are apparent together with evidence of reworking in some of the pebbles, and the textural heterogeneity of the matrix components (e.g. North Wejinabikun Lake). A lineation defined by elongation of clasts and matrix components is locally found in the conglomerate. Excellent exposures of relatively undeformed conglomerate occur along the shores of the small lake in southeast Nameigos Township (see section on Volcanic Breccia, Mafic to Intermediate Metavolcanics.

The major components of the matrix of the conglomerate are plagioclase, hornblende, quartz, and biotite. Owing to recrystallization distinction between the original coarse clasts and matrix material is seldom possible; the grain size varies generally between 0.4 and 1.8 mm and recognizable matrix material has size of about 0.008 to 0.02 mm. Plagioclase is mostly untwinned; it was found to be albite (An_4) in one of the 16 thin sections that were examined, and andesine (An_{34-39}) in two others. Hornblende, quartz, and biotite account for 6 to 50 percent, 5 to 30 percent, and 7 to 15 percent in volume of the rock, respectively. The accessories are one or more among chlorite, penninite, epidote, microcline, carbonates, muscovite, hematite, garnet, and zircon (in biotite or hornblende). Where the clastic texture is still recognizable biotite and hornblende are uniformly distributed throughout the rock; more commonly, however, the mafic and felsic components occur in discrete bands which may be quite well defined. The matrix of the conglomerate is probably the metamorphic derivative of a feldspathic greywacke (Pettijohn 1957). The conglomerate has originated from reworking of the volcanics and, to a much lesser extent, of the early granitic rocks of the area, since recognizable granitic pebbles occur in deformed conglomerate at one locality of the southern belt.

NORTHERN BELT

In the northern belt a prominent outcrop of conglomerate occurs slightly inland, and on the north side, of the first set of rapids of Kabinakagami River (northwestern Mosambik Township). This occurrence is isolated and could not be traced to other areas. This rock differs remarkably from the conglomerates in the central and southern belts. The colour of the matrix and of most of the clasts is grey; the clasts consist of metasedimentary and trondhjemitic rocks and of a structureless light grey rock which could be a recrystallized felsic volcanic. The matrix is coarse, gritty, and texturally very heterogeneous. The conglomerate strikes N10W, dips at 45 degrees to the west with tops in the same direction (Photos 11, 12), and was deformed by flattening parallel to bedding. Stretching of the clasts and matrix components define a variably well developed west-plunging lineation on the bedding plane. Prominent ridges caused by differential erosion of the rock adjacent to silicified joint planes occur in this rock (Photo 13); similar, although less prominent, silicified joints occur in all the metasediments.



OGS9734

Photo 11–Conglomerate, metasedimentary, and trondhjemitic clasts in relief owing to stronger erosion of the gritty softer matrix of the rock.

OGS9735

Photo 12–Conglomerate, approximately 3 m (10 feet) west of Photo 11. Note overall decrease in size of clasts.

OGS9796

Photo 13–Conglomerate, same locality as Photo 11. Note prominent silicified joints. Dark spots on rock are lichen; black area in bottom left-hand corner is water.

A thin section of the matrix shows that it consists of three components. The first component accounts for about 47 percent in volume of the matrix and consists of a thoroughly recrystallized groundmass of a) subangular feldspar and quartz grains with size of 0.028 to 0.04 mm, and b) euhedral epidote (clinozoisite?) microlites with length in the same order of magnitude and much smaller width. The feldspars are mostly alkalic (i.e. albitic plagioclase, potassic feldspar), and the proportions of feldspars, quartz, and epidote are about 6:1:3. The second component forms about 38 percent in volume of the matrix and consists of an aggregate of subhedral microcline, perthite, oligoclase (An_{20}), and quartz 0.18 to about 2 mm in size; the larger feldspathic grains are variably altered plagioclase whereas quartz, microcline, and perthite are fresh-looking products of metamorphic recrystallization. The third component accounts for the balance of the matrix and consists of euhedral biotite tabulae and prismatic hornblende crystals in about equal proportions, and up to 2.7 mm in size. A thin section of an "average-looking" metasedimentary pebble shows that it consists of two components. The first component forms 75 percent in volume of the pebble and consists of an aggregate of subrounded quartz and anhedral altered plagioclase (oligoclase?) up to 2.7 mm in size. The second component, or void-filling material accounts for the balance of the pebble and consists of fresh-looking recrystallized quartz, epidote, and hornblende in proportions of about 3:3:2, the remaining 20 percent being untwinned plagioclase and microcline with lesser biotite and traces of hematite. The assemblages of recrystallized alkali feldspars, epidote,

OGS8787

Photo 14–Paragneiss; granitized metasediments interbedded with metavolcanic sands (not shown in photo) and cut by diabase dike (left side of photo). Mosambik Lake area.

and biotite in the matrix, and of epidote, biotite, and microcline in the pebble of the conglomerate indicate that the latter underwent middle greenschist facies metamorphism (i.e. quartz-albite-epidote-biotite subfacies). The overall felsic character of the conglomerate together with the heterogeneous nature of the matrix, and the presence of oligoclase relics in the matrix and possibly in the clast, suggest that the main source materials for this rock were either early granitic rocks, or metasediments which previous to erosion and redeposition could have undergone upper amphibolite metamorphism.

Sandstone and Paragneiss

Sandstone occurs as occasional biotite-rich interbeds, about 10 cm (few inches) to perhaps 0.6 m (2 feet) in thickness, within metavolcanics. In both appearance and microscopic character, the rock is the same as the matrix of the conglomerate of the central and southern belts. Paragneiss is a higher metamorphic equivalent of sandstone characterized by total obliteration of the clastic fabric, coarser grain size, and the metasomatic addition of silica and alkalies as the result of incipient granitization in proximity to the contact zones (Photo 14).

Garnetiferous Metasediments

Disseminated garnet crystals 0.5 to 1.5 mm (0.02 to 0.06 inch) in size occur in concentrations of 1 to 3 percent in a few outcrops of sandstone interbedded in the mafic metavolcanics in northeastern Nameigos Township. No thin sections of these rocks were examined.

Abundant garnet crystals up to about 38 mm (1.5 inches) in size occur in some erratic boulders of strongly metamorphosed coarse-grained metasediments found along the north shore of the lake with the elliptical outline in northeastern Nameigos Township; these boulders are not of local derivation.

Iron Formation

The presence of lean iron formation bands locally interbedded with the metavolcanics is mostly inferred from interpretation of aeromagnetic data. There is little field evidence. A small aeromagnetic anomaly of oval shape and a peak total field value of 60,240 gammas underlies the eastern shore of Nameigos Lake close to the outcrop area of a 3 m (10 feet) wide pyritic band (ODM-GSC 1963c and "Economic Geology" section, Occurrence 2). This pyrite is thought to correspond to a small sulphide-facies iron formation band striking approximately north. A west-trending unexposed iron formation band of similar type is believed to occur approximately 1.9 km (1.2 miles) north of the relatively large lake of elliptical shape in northeastern Nameigos Township; the area is underlain by metavolcanics containing interbeds of garnetiferous sandstone and the peak value of its aeromagnetic relief is 60,700 gammas.

FELSIC INTRUSIVE AND METAMORPHIC ROCKS

The granitic rocks are poorly exposed in Nameigos and Carney Townships and all but the southeastern part of Mosambik Township, are moderately well exposed in western Doucett Townhip, and are very well exposed throughout Cudney and western Simpson Townships. The terms quartz monzonite, granodiorite, and trondhjemite, used in the following descriptions, refer to granitic rocks containing more than 10 percent quartz and in which the ratio of potassic feldspar to total feldspars is between 0.66 and 0.33, between 0.33 and 0.12, and less than 0.12 respectively. Trondhjemite, the least abundant granitic type, occurs as a main component of migmatite in contact zones, and as syntectonic intrusive sheets which locally possess a variably well developed cataclastic fabric. Granodiorite and quartz monzonite are the dominant granitic types. They are mostly found in areas far from the metavolcanics, and occur as relatively uniform local bodies (e.g. south-central Esnagi Lake), and as dominant components of multiphase granitic intrusions. The intrusive relationships of multiphase intrusions may be generalized as follows: a) metamorphosed trondhjemite which may contain inclusions of supracrustal rocks either grades into , or occurs as, sharply defined xenoliths within b) massive to crudely foliated coarse-grained

granodiorite enclosed within c) massive coarse-grained to pegmatitic quartz monzonite. Relationships less simple than these can occur owing to the presence of more than one type of each phase and of quartz vein networks. A subdivision of the granitic rocks into three main categories is used below for descriptive purpose; these are 1) trondhjemite, 2) granodiorite and granodiorite to trondhjemite, and 3) quartz monzonite. The mineralogical descriptions relevant to the first two are based on 14 thin sections.

Trondhjemite

This includes dominant biotite trondhjemite, lesser hornblende-biotite trondhjemite, and minor biotite-hornblende trondhjemite; the presence of amphibole in the hornblende-bearing phases appears to be related to assimilation of metavolcanics.

Biotite Trondhjemite

This is a gneissic medium-grained rock which is mostly grey to light brown in colour and consists of oligoclase (An_{17-19}), quartz, and biotite with subordinate amounts of microcline and perthite; the accessory minerals are one or more among sericite, chlorite, muscovite, epidote, magnetite, pyrite, sphene, apatite, and zircon (in biotite). Biotite accounts for 5 to 15 percent in volume of the rock, and is present as fresh-looking strongly pleochroic lamellar aggregates which define foliation, and only seldom are affected by chloritic alteration. Mylonitization and recrystallization have locally affected the rock converting it to a groundmass with grain size of a fraction of a millimetre containing small recrystallized porphyroclasts of quartz and feldspar of ovoidal shape (e.g. Western Nameigos Township).

Hornblende-Biotite Trondhjemite and Biotite-Hornblende Trondhjemite

The total mafic content of trondhjemites averages about 12 percent by volume; approximately one sixth to one third of this content is hornblende in hornblende-biotite trondhjemite, and is biotite in biotite-hornblende trondhjemite. Apart from the presence of amphibole, the occasional chloritization of hornblende rather than of biotite, and the rare occurrence of garnet as accessory of biotite-hornblende trondhjemite, both these rocks are similar to biotite-trondhjemite. The hornblende-rich phase is, however, more easily recognized in the field. Where large metabasalt xenoliths were assimilated by biotite-hornblende trondhjemite the resulting rocks have the composition of intrusive quartz diorite and diorite. The metamorphic conditions under which the dioritic rocks developed do not seem to have exceeded significantly upper amphibolite rank.

Granodiorite and Granodiorite to Trondhjemite

This group includes dominant granodiorite and subordinate trondhjemite; owing to assimilation of the latter by part of the former in several outcrops of multiphase granitic intrusions the two phases can grade imperceptibly into each other. The relative amounts of trondhjemite and granodiorite in a given outcrop can be estimated by using one or more of the following general criteria; with respect to the granodiorite areas of the outcrop the trondhjemitic areas are characterized by: 1) higher mafic content, 2) finer grain size, 3) recognizable hornblende-rich xenoliths and/or groundmass hornblende (not always applicable), 4) lack of a) epidotization, b) euhedral phenocrysts of feldspars and quartz, and c) magnetite nodules, 5) better defined gneissic structure, and, where applicable 6) discordant trends of gneissosity in different (trondhjemitic) areas of the same outcrop. Colour contrast is generally indicative of significant changes in concentration of mafics; however, where the surface of the outcrop is subparallel to the plane or planes of gneissosity of the trondhjemitic domains, the colour contrast is dramatically emphasized and has little or no significance. The granodiorite is coarse to medium grained, light grey to pink and occasionally dull white, and is generally massive although gneissic varieties do occur. It consists of microcline, exolution perthite, quartz, oligoclase (An_{14-20}) and occasionally andesine (An_{29}), with subordinate biotite; the accessory minerals are one or more among chlorite, sericite, muscovite, epidote, magnetite, hematite, pyrite, sphene, rare hornblende, and zircon (in biotite). The alkali feldspars are mostly present as fresh-looking euhedral grains; two types of plagioclase may be present one being relatively unaltered oligoclase and the other being strongly altered to completely decomposed plagioclase which is probably more calcic in composition. Biotite accounts for 4 to 7 percent by volume of the rock and is variably altered to chlorite. Epidotization along joint planes and shear fractures is not uncommon in granodiorite and quartz monzonite. Possibly this epidotization, the chloritization of biotite, and the alteration of plagioclase are all related to the same deuteric process.

Quartz Monzonite

Quartz monzonite is the youngest granitic phase and commonly intrudes the granodioritic and trondhjemitic rocks in the form of large, coarse-grained to pegmatitic dikes, sills, and discordant bodies of variable size; it also occurs as medium-grained dikes that are generally 0.3 to 1 m (1 to 3 feet) wide, and are very homogeneous in texture. Metavolcanic xenoliths are much less frequent in quartz monzonite than they are in granodiotite and trondhjemite, and where quartz monzonite intrudes the metavolcanics the contact relationships are sharp and discordant. The quartz monzonite is locally porphyritic owing to the presence of euhedral potassic feldspar phenocrysts up to 10 cm (4 inches) in size within a matrix with grain-size of about 1.3 cm (0.5 inch); potassic feldspar crystals up to 23 cm (9 inches) in size were noted in pegmatitic quartz monzonite. The colour of the feldspathic and quartz fabrics in the pegmatitic and coarse-

grained rock varies from frosted red to mat pink, and translucent to opaque white, respectively; where limited assimilation of granodiorite has developed, and also in local weathered areas at interface with water or thin moss, the quartz monzonite tends to acquire a rather uniform pinkish white colour. The rock consists of potassic feldspar, quartz, and plagioclase which is probably oligoclase, and contains 1 to 4 percent biotite; up to 7 percent biotite books about 2.5 cm (1 inch) in size were locally noted in pegmatite. Disseminations of magnetite nodules are commonly found in local areas of quartz monzonite and granodiorite. All these occurrences consist of magnetite nodules generally 1.6 to 3.2 mm (0.06 to 0.12 inch) and occasionally up to 13 mm (0.5 inch) in size which occur in local concentrations of 1 to 3 percent within granitic and pegmatitic rocks. Rare molybdenite disseminations also occur in potassic granitic rocks, but apparently, only where these have intruded the volcanics (see "Economic Geology" section, Occurrences 2 and 6).

Muscovite-Bearing Quartz Monzonite

Muscovite is occasionally present as a minor groundmass component of potassic granitic rocks, but apart from this mode of occurrence it is quite rare; approximately 5 percent muscovite books up to 5 cm (2 inches) in size occur in one outcrop of pegmatitic quartz monzonite on the east side of Esnagi Lake in northern Cudney Township.

Time and Space Relationships of Granitic Rocks

TIME RELATIONSHIPS OF CONCORDANT TRONDHJEMITE SHEETS

With regard to these rocks the following two conditions obtain.

1) The surface delimiting the sheets parallels the metamorphic foliation of the volcanics and clearly this foliation has controlled the emplacement of trondhjemite. It follows that the intrusion of trondhjemite did not predate the onset of metamorphic foliation in the volcanics.

2) The trondhjemite sheets are gneissic and the gneissosity parallels the metamorphic foliation of the volcanics. This indicates that the sheets and the volcanics were deformed together. In fact it is extremely improbable that successive strains affected selectively either the volcanics or the trondhjemite but not both at the same time, and in such a way that the superposition of these strains resulted in parallelism of gneissosity and foliation in different parts of the area. It follows that the intrusion of trondhjemite did not predate the end of metamorphism of the volcanics.

Because of (1) and (2) the trondhjemite sheets are regarded as early syntectonic intrusions.

TIME RELATIONSHIPS OF MULTIPHASE GRANITIC ROCKS

The intrusive relationships of these rocks indicate that successive granitic phases were characterized by overall increase in potassic content. Also, the unmetamorphosed state of the more potassic parts of these rocks indicates that sources of potassic-rich granitic magma existed toward the end of, and after regional metamorphism.

SPACE RELATIONSHIPS OF GRANITIC AND SUPRACRUSTAL ROCKS

The granitic rocks west of the central belt are poorly exposed and the areas of relatively good outcrop density are only two. Both these areas are small in size, are adjacent to the metavolcanics, and are underlain by trondhjemite. The granitic rocks east of the central belt are well exposed, and show that trondhjemite, as dominant or subordinate component of individual outcrops, occurs only from the eastern boundary of the metavolcanics to about midway between the eastern shore of Mosambik Lake and the western shore of Esnagi Lake. In the Esnagi Lake area the dominant granitic type is by far pegmatitic quartz monzonite. This type is also dominant in well exposed granitic outcrops south of the southern belt, and at a distance of 1.2 to 2.4 km (0.75 to 1.5 miles) from the latter. These conditions indicate that sodic granite (i.e. trondhjemite) is scarce and is spatially closely associated with the metavolcanics around which it forms a narrow discontinuous rim.

SYNTHESIS

The above time-space relationships are interpreted as follows. Deformation and regional metamorphism of the supracrustal rocks was coeval with sodic granitic plutonism developing in marginal areas of the volcanics (e.g. eastern and western side of central belt). Concordant injections originated from these zones, intruded the volcanics, and were subsequently metamorphosed together with the volcanics by deformation associated with growth and rise of the sodic granitic plutons in the marginal zones. Because of the long exposure to magmatic conditions, local volcanic areas in contact with the rising plutons were locally remelted and assimilated; in the eastern side of the central volcanic belt large volcanic xenoliths were also detached and removed at some distance from the contact by magmatic currents. The final stage of tectonism and the posttectonic time were characterized by the uprise of potassic magma which assimilated large volumes of the early intrusions but had little effect on the supracrustal rocks. In areas far from the volcanics the trondhjemite was thoroughly assimilated and the resulting rock is a rather uniform pegmatitic quartz monzonite within which recognizable trondhjemitic xenoliths are not uncommon. Close to the metavolcanics the trondhjemite was affected mostly by rheomorphism and little assimilation.

The outlines and the structural features of the volcanic belts indicate that these rocks are small infra-batholithic occurrences and strongly suggest that the emplacement of the granitic batholiths surrounding them was the direct cause of deformation of the volcanics to their present structural set-up. If this was the case, it is evident that the granitic rocks surrounding the metavolcanics are largely anatectic. In fact the causal relationship implies that the granites presently surrounding the metavolcanics were emplaced during deformation of the volcanics; with the exception of narrow trondhjemitic areas at the rims of the metavolcanics these granites are, however, essentially massive potassic types and are obviously of posttectonic to late tectonic age. Therefore they could not have existed during major deformation of the volcanics unless at that time they were trondhjemite which, subsequently, underwent large-scale assimilation and potassium metasomatism (i.e. anatexis). The lack of syntectonic potassic intrusions would suggest that indeed no sources of potassic granitic magma existed adjacent to the volcanics during deformation.

Middle to Late Precambrian (Proterozoic)

MAFIC INTRUSIVE ROCKS

Diabase Dikes

The youngest Precambrian rocks in the map-area are numerous northwest-trending and lesser northeast- to north-trending diabase dikes. During the 1972 field season minor amphibolite and lamprophyre dikes were found in the Kabinakagami Lake area (Siragusa 1977) but none were found in the outcrops visited in the present map-area. The diabase dikes are commonly vertical or nearly so, are generally a few to 30 m (few to 100 feet) wide but may be up to 60 m (200 feet) thick, and have glassy chill margins which in the larger dikes can be up to 0.76 m (2.5 feet) wide and may contain fragments of the rock intruded by the diabase. The dikes almost invariably contain local disseminations and tiny stringers of pyrite, and are commonly porphyritic owing to the presence of altered plagioclase phenocrysts up to 7.6 cm (3 inches) in size (Photo 15); the size, frequency, and distribution of these phenocrysts may vary considerably within different segments of the same dike. The diabase is essentially a massive, fresh-looking, intense green to dark green rock weathering to a characteristic reddish brown which hardly penetrates the rock for more than a few millimetres. In two thin sections the rock is seen to consist of dominant andesine (An_{47}) which is weakly to moderately saussuritized, and contains about 20 percent by volume of pigeonite, and accessory olivine, biotite, pyrite, and zircon (in biotite). Most dikes are quite homogeneous in texture and have grain size of 1 to 2.5 mm but dikes wider than about 9 m (30 feet) or thinner than approximately 2.5 m (8 feet) may vary from these limits, the thinner the dike the finer the grain-size, and vice versa.

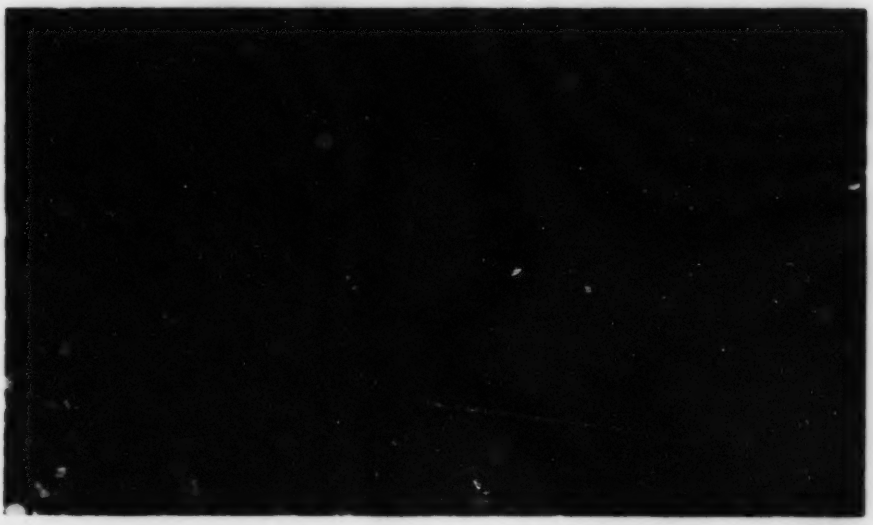


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Photo 15–Porphyritic diabase dike. Eastern Mosambik Township.

Cenozoic

QUATERNARY

Pleistocene and Recent

The Quaternary deposits consist primarily of silty to sandy till containing some lime-rich clay and variable proportions of pebbles and boulders. Pebbles of Paleozoic limestone and dolostone are found mixed with the predominantly granitic coarse fraction of the till and erratic boulders are found from hilltop to the water edge. Most of these boulders consist of metavolcanic and granitic rocks of local derivation; subangular boulders of high-grade metasediments containing abundant garnet were noted along the northern shore of a small northwest-trending lake in central Nameigos Township. In local areas of Carney Township the thickness of the till sheet was seen to be about 5 m (18 feet) but over most of this township the thickness is probably much more. Deposits of sand are found in local shoreline areas of the main lakes, in two eskers in Carney and Simpson Townships, and in another two in Nameigos and Doucett Townships. Local areas of northern Mosambik Township are covered by glaciolacustrine deposits

of clay, silt, and sand that are a small isolated part of the Ontario clay belt (Boissonneau 1965) formed by glacial Lake Ojibway-Barlow about 9,000 to 10,000 years ago (Prest 1970, p.714-725).

Three of the four eskers found in the map-area trend northeast and one trends north-northeast; the trend of the glacial striae in five out of the six localities in which they were found is north-northeast, and is north-northwest in the sixth locality. The predominance of northeast and north-northeast trends in the glacial features agrees with the results of Boissonneau's (1966) work on the direction of ice movement in the Cochrane-Hearst area. He observed that the trend of the glacial features is southwest in the western part of the area (which includes the present map-area) but southeast in the eastern part of the area, thus indicating a regional fan-shaped ice movement over the Cochrane-Hearst area.

STRUCTURAL GEOLOGY

Small-Scale Metamorphic Structures

Foliation is variably well developed in all rocks except some of the large mafic xenoliths in migmatite, the most potassic granitic phases, and the diabase dikes. In the metavolcanics the strike of foliation tends to parallel the overall trend of the belts and of their associated aeromagnetic expressions. Also, where metasediments or felsic metavolcanics were found interbedded with the mafic metavolcanics the bedding and foliation planes were seen to coincide. Thus, where bedding evidence is lacking in the mafic metavolcanics, as is most often the case, the foliation and bedding planes were assumed to be parallel.

Southwest-plunging lineations defined by elongation of matrix elements and clasts occur in local areas of the central belt underlain by volcanoclastic rocks (see "Folds" subsection).

Small quartz boudins were noted in mafic metavolcanics and metasediments as the result of flattening of quartz veins parallel to metamorphic foliation (Photo 16).

Shearing accompanied by silicification and development of retrograde chlorite may be found in amphibolite-grade mafic metavolcanics. Shearing has also affected to variable extent some of the syntectonic (or pretectonic) trondhjemitic rocks marginal to the northern edge of the southern belt.

The occurrence of prominent silicified joints subnormal or oblique to bedding in the metasediments has already been mentioned. Joints and incipient shear fractures are also commonly found in the granitic rocks with the possible exception of pegmatite,and are occasionally found in the supracrustal rocks. Subvertical jointing parallel to strike was noted in a few diabase dikes.

OGS9789

Photo 16–Quartz boudins in paragneiss; black spots are lichen. Note small silicified joint under transparent part of silva compass. Western Mosambik Township.

Large-Scale Metamorphic Structures

FAULTS

Esnagi Lake is the locus of a northeast-trending fault which truncates the metavolcanics of the southern belt in Cudney Township. The metavolcanics occur on the western shore of the lake, trend east-southeast, dip vertically to steeply to the south, and have a thickness of approximately 365 m (1,200 feet); slightly inland of the lakeshore these rocks form a prominent hill which is 121 m (400 feet) above the lake level. Yet, although the lake is very narrow, no significant metavolcanics are found along, or inland of, the eastern shore where only a few strongly metamorphosed small xenoliths are present within granitic rocks. An unusually large xenolith occurs south of the narrow northeast-pointing bay at the northern end of Esnagi Lake. This xenolith consists of nearby massive coarse hornblende, is about 14 m (45 feet) wide at its largest point, is surrounded and locally intruded by granodiorite, and was intermittently traced for about 700 m (2,400 feet) into the bush; it is most unlikely that this unit is correlatable with the faulted metavolcanics in Cudney Township. It occurs within a migmatitic fringe marginal to nearby metavolcanics of the northern belt (see "Contact Relationships with the Granitic Rocks" subsection). Thus, displacement along the Esnagi Lake fault remains undetermined.

In western Nameigos Township metavolcanics and granitic rocks are in contact along a straight segment of Nameigos River, 2225 m (7,300 feet) long. The area along, and south of, the southern bank is underlain by essentially massive potassic granitic rocks which locally assimilated metavolcanics; good exposures of massive dioritic rocks derived from assimilation occur in close proximity of the old log cabin found in the area. The northern bank is underlain by metavolcanics locally intruded by quartz-microcline pegmatite. These metavolcanics are in contact with granitic rocks at an assumed distance of about 150 m (500 feet) from the river and to the north of it; the precise distance is unknown owing to the scarcity of granitic outcrops. The granitic rocks found in the area consist essentially of strongly sheared trondhjemite with the shear plane trending west-southwest and dipping 32 to 40 degrees to the south and it is suggested that the metavolcanics and the trondhjemite are in fault contact. Another fault has displaced these metavolcanics an estimated 600 m (2,000 feet) north and 457 m (1,500 feet) west of the main body of the southern belt. This fault crosses the south end of Nameigos Lake in an area of water and swamp with no exposures, and consequently its trend can only be assumed to be northwest. A northward thrust exerted by the late tectonic potassic granitic rocks south of the river could explain the shearing of trondhjemite north of the river and the northward component of displacement in the northwest-trending fault. Thus, shearing and possibly minor overthrusting developed at the interface of the volcanics and the early granitic rocks underlying them north of the river, and partial assimilation occurred at the interface of the volcanics and younger potassic rocks owing to the molten state of the latter at the time of faulting.

FOLDS

The structural interpretation of the northern belt is problematic owing to the scarcity and scattered distribution of the outcrops. The strike of foliation in these outcrops is essentially parallel to the trend of the belt. Opposite dip directions in a few outcrops in the northeast and southeast margins of the belt suggest that it was folded about an axis, or axes, parallel to its west-northwest trend.

The metavolcanics of the central and southern belts were folded and warped by the granitic intrusions emplaced at their margins. The structural set-up of these belts is schematically illustrated by Figure 6. The central belt is a vertical synform the axial plane of which is gently folded about a vertical axis and thus is concave toward the west. The curved line "a" in Figure 6 is the trace of the axial plane of this main fold on the horizontal plane; in order to simplify the drawing a "valley" is shown in the core of the fold which in reality is occupied by steeply dipping metavolcanics. Over most of its length the fold is relatively well defined by the reversal of dip-direction along the centre-line of the belt and by the progressive change of the foliation trend from south to north; for both limbs of the structure the dip angles of foliation vary between about 50 degrees at the margins of the fold to subvertical dips at its centre. A westward decrease in the size of clasts in clastic metavolcanics in the eastern limb of the fold (see "Agglomerate" subsection), and some south-facing pillowed metavolcanics in the

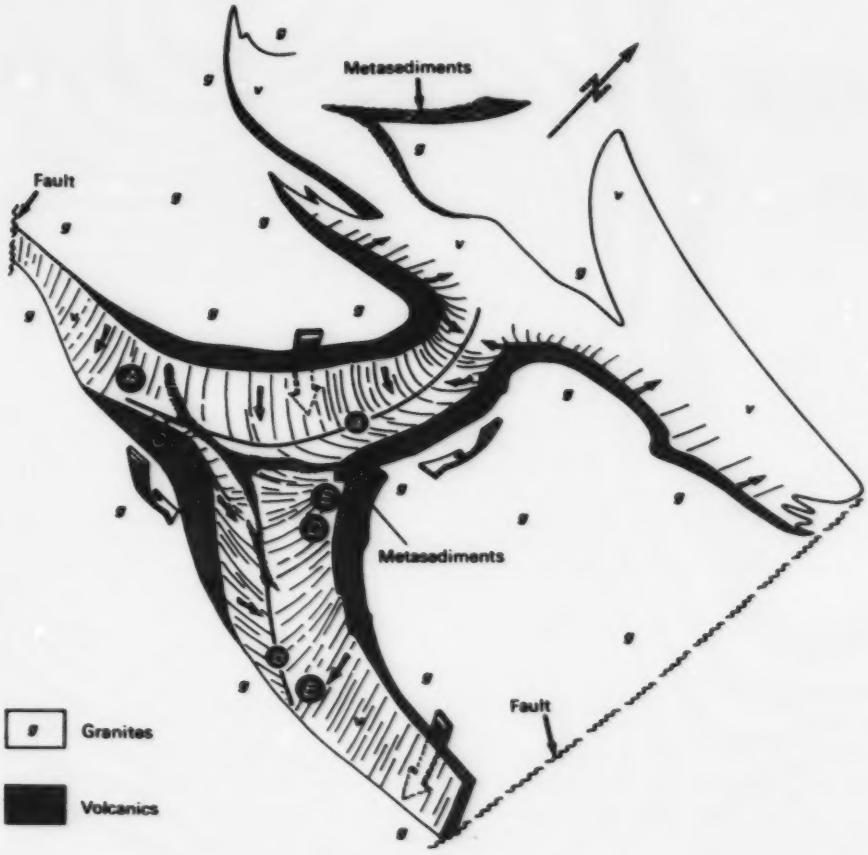

Figure 6–Simplified schematic diagram illustrating the main structural features of the Nameigos-Simpson metavolcanic-metasedimentary belt. The thick lines represent the top of the series and the arrows indicate the directions of dip; lines a and b represent intersections of axial planes of synclinal folds with the horizontal plane. The meaning of the points A,B,C,D,E, is explained in text. Approximate scale 1 cm to 1.1 km (1 inch to 1.75 miles).

southern part of the western limb of the synform, suggest that this synform is a syncline. All but the western tip of the metasedimentary band stretching through the central segment of the southern belt and the southeastern part of the central belt, is within the eastern limb of the main syncline. In the area marked by point A in Figure 6 the main syncline gives place to the south-dipping homocline which forms the western lobe of the southern belt. The metavolcanics in the central part and at the southern margin of the southern belt (area C in Figure 6) dip to the north, and the clastic supracrustal rocks in the North Wejinabikun Lake area (point B in Figure 6) show a well defined lineation plunging at 30 to 35 degrees to the southwest which is consistent with the existence of a southwest-plunging anticline in the area D of Figure 6; the upward warping of the metavolcanics in areas C and D has resulted in a relatively small synclinal fold the axial plane of which intersects the horizontal plane along the line b. In the area marked by point E in Figure 6 this syncline gives place to the south-dipping to subvertical homocline which forms the eastern lobe of the southern belt.

ECONOMIC GEOLOGY

Three of the four mineral occurrences which were known to occur in the area previous to present mapping are associated with the metavolcanics underlying Nameigos and western Mosambik Townships; the fourth is a copper float occurrence in the Anaharea Lake area of Doucett Township. These occurrences were not visited during the 1973 survey; data on their location, development, and geological setting were compiled and published by P E. Giblin (1968). This publication has been out of print since 1971 and for the reader's convenience all the data contained therein are given in the present report. Another 16 minor occurrences were found during the 1973 summer; these include two molybdenite occurrences, two pyrite occurrences one of which contains minor copper and zinc, and 12 magnetite occurrences. The two molybdenite occurrences and the pyrite occurrence with minor copper and zinc are associated with metavolcanics, and the remaining 13 occurrences are associated with granitic rocks. As the map-area has received little attention in the past the available information is very scarce. Therefore it was felt advisable to show all the known and found occurrences on the Geological Map (back pocket); as of April 15, 1975 all the listed occurrences were open for staking. In the summer of 1973 a crew of Rio Tinto Canadian Exploration Limited was in the area; on April 16, 1974 a group of 36 unpatented claims in Mosambik Township were registered under the name of Mr. A. Gervais. These claims are numbered TB388673, TB388674, TB388676, TB388677, TB388683 to TB388687 inclusive, TB388691 and TB400872 to TB400897 inclusive, and on January 29, 1975 two of these claims, TB400888 and TB400889 were transferred to Rio Tinto Canadian Exploration Limited. These claims are located on the western side of the central belt but at the time of writing no information is available to the writer as to the activity which might have followed claim staking in the area.

Description of Mineral Occurrences

NAMEIGOS TOWNSHIP

Nameigos Lake Occurrence (1)[1]

PYRITE WITH TRACES OF SPHALERITE AND CHALCOPYRITE

Location: Northern Nameigos Township; northeast side of the prominent north-pointing promontory on the eastern shore of Nameigos Lake. Mineralization occurs in a band 3 m (10 feet) wide within the metavolcanics striking N40E. It consists of pervasive fine-grained pyrite within, and of massive pyrite stringers up to 1.2 cm (0.5 inch) interbedded with, strongly weathered schists containing an estimated 40 percent combined biotite and chlorite. The mineralization is quite obvious owing to the prominent rusty staining along the lakeshore. A few specks of sphalerite and chalcopyrite occur in the pyrite stringers. A composite grab sample of pyritized schist was taken by the writer and analyzed by the Mineral Research Branch of the Ontario Division of Mines. It analyzed 0.25 percent zinc and 0.05 percent copper.

Nameigos River Occurrence (2)

MOLYBDENITE

Location: Western Nameigos Township; northern riverside of Nameigos River approximately 1295 m (4,250 feet) east of the western boundary of the township. One molybdenite crystal 0.6 cm (0.25 inch) in size occurs in pegmatitic quartz monzonite locally intruding mafic metavolcanics.

Nameigos River Occurrence (3)

MOLYBDENITE

The following description is excerpted from P.E. Giblin (1968, p.17):

Location: West-central part of Nameigos Township; on a low cliff face on north side of a creek at its junction with the Nameigos River.
Minerals Present: Pyrite and molybdenite
Development: Trenching

[1]Number refers to property number on Map 2382, back pocket.

Geology: Pyrite and molybdenite occur in a band of felsic metavolcanics which is 0.6 to 0.9 m (2 to 3 feet) wide. No assays or dimensions of the showing are available.

Stenabaugh Occurrence (4)

GOLD AND SILVER

This occurrence was discovered by J.E. Stenabaugh in the summer of 1935, was optioned by Consolidated Mining and Smelting Company of Canada Limited (presently Cominco Limited) in January of 1936, and was abandoned in the month of June of the same year (Resident Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie, File No 1051). The following descriptions are excerpted from P.E. Giblin (1968, p.16-17):

Location: Northeast part of Nameigos Township.
Minerals Present: Pyrite
Development: Stripping and trenching, 1935-36.
Geology: A silicified zone, carrying seams of pyrite, cuts obliquely across the strike of mafic metavolcanics. The zone strikes N50°W and dips 70° to 75°NE. Dimensions of the zone are not recorded.
Eleven samples taken along a cross-trench, each representing a length of 0.9 m (3.0 feet), assayed trace Au in four samples; 0.10 oz. Au in three samples; the others assayed 0.02, 0.04, 0.22, and 0.22 oz. Au per ton. One 0.6 m (2 foot) sample assayed 0.24 oz. Au per ton (File SSM-1051).
M.W. Bartley (1958) reported an assay of trace Au and 0.12 oz. Ag from a sample representing a width of 200 cm (80 inches).

MOSAMBIK TOWNSHIP

Mosambik Township Lithium Occurrence (5)

The following description is excerpted from P.E. Giblin (1968, p.16):

Location: West-central part of township (Mosambik).
Minerals Present: Spodumene and lepidolite.
Development: Stripping.
Geology: A calcite-quartz-feldspar vein, having an average width of 50 cm (20 inches) and an exposed length of 115 m (375 feet), occurs in an area underlain by metavolcanics and metasediments.
Bartley (1958, p.8) in referring to the vein, stated: "Calcite is the main constituent. Considerable lepidolite or lithium mica was noted, plus a very weathered spodumene crystal. However, on analysis, only a trace of lithium was detected. Minor fluorite is also present. No gold or silver was noted."

Mosambik Township Molybdenite Occurrence (6)

Location: Western Mosambik Township; small lake with centre at 610 m (2,000 feet) east and 5.79 km (3.6 miles) north of southwestern corner of township. An irregularly shaped small body of granodiorite intrudes the mafic metavolcanics on the west side of the very narrow north-pointing promontory on the southeast lakeshore. The granodiorite is exposed at the water edge and is cut by a quartz vein about 10 cm (4 inches) thick. An estimated 2 percent pervasive mineralization of fine-grained molybdenite occurs in the quartz and surrounding granodiorite; the mineralized area of the granodiorite is approximately 2.2 m^2 (24 square feet). A composite grab sample of mineralized granodiorite was taken by the writer and analyzed by the Mineral Research Branch of the Ontario Division of Mines. It analyzed 0.11 percent molybdenum.

DOUCETT TOWNSHIP

Anaharea Lake Occurrence (7)

COPPER FLOAT

The following description is excerpted from P.E. Giblin (1968, p.3,4):

Location: Northeast part of Doucett Township, on northeast shore of Anaharea Lake.

Minerals present: Pyrite, pyrrhotite, and chalcopyrite.

Development: None.

Geology: Pieces of mineralized metavolcanic-metasedimentary rock were found south of the belt of metavolcanics and metasediments which trends northeastward across the north end of Anaharea Lake.

No assays are available.

Bartley (1958, p.10) stated that "although the chalcopyrite is not abundant, there is enough present to warrant further prospecting for its source".

Remarks: The direction of glacial transport in this area appears to have been from S10°W to S25°W.

During the 1973 summer the area was visited and although boulders of metavolcanic migmatite occur in the area no mineralization could be found in them. The metavolcanic "belt" across the north end of the lake is apparently the thin northwest-trending metavolcanic xenolith shown on the map in the back pocket.

CUDNEY TOWNSHIP

Cudney Township Occurrence (8)

PYRITE

Location: South side of northernmost bay on eastern shore of the lake with centre at 3.77 km (2.36 miles) west and 4.65 km (2.91 miles) south of northeast corner of Cudney Township. Mineralization occurs along 7 m (23 feet) of the shore and consists of pyrite disseminations in granodiorite emphasized by ochraceous staining of the rock.
No analysis data are available for this showing.

RUSTY STAINS IN METAVOLCANICS

These are not uncommon and result from minor pyrite disseminations which tend to occur parallel to metamorphic foliation. Qualitative spectrographic analyses of "rusty" volcanics from three localities revealed only traces of titanium in one locality, and traces of titanium and zinc in another; the latter, however, refers to an area in close proximity of Nameigos Lake Occurrence (1).

Recommendations to Prospectors

The available data on base metal mineralization in the area are not encouraging particularly if one's exploration philosophy centres on significant amounts of felsic pyroclastic rocks.

However, the volcanics within the present map-area are the southern extension of the Kabinakagami Lake belt which hosts a past gold producer (Siragusa 1975, p.59), and gold is also known to occur at one locality in the northern belt area of this report (see Stenabaugh Occurrence, 4). The volcanics are well exposed particularly across the central belt and, to the writer's knowledge, this area is as yet unexplored presumably because most of the past exploration activity was attracted by the areas immediately adjacent to the past gold producer in Lizar Township, outside and to the north of the present map-area. The volcanics of the central and southern belts could contain gold and the finding of ultramafic volcanics at one locality within the lower stratigraphic section of the series may be significant in this respect.

Because of scarcity of outcrops in the northern belt it is not recommended to persons wishing to rely primarily on observable geological evidence; geophysical interpretation followed by drilling appears to be the only practical way of tackling the volcanics particularly in the eastern part of the belt, if one wants to assess their mineral potential.

REFERENCES

Bartley, M.W.
1958: Private report on Prospecting in the Kabinakagami Lake Area to the Dept. of Industrial Development, Canadian Pacific Railway Company; on file in Resident Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie.

Boissonneau, A.N.
1965: Algoma-Cochrane Surficial Geology; Ontario Dept. Lands and Forests, Map S365, scale 1 inch to 8 miles. Surficial geology 1962 to 1963.
1966: Glacial History of Northeastern Ontario: the Cochrane-Hearst Area; Canadian J. Earth Sci., Vol.3, p.559-578.

Fenwick, K.G.
1967: Geology of the Dayohessarah Lake Area; Ontario Dept. Mines, GR49, 16p. Accompanied by Map 2129, scale 1 inch to 2 miles.

Fyfe, W.S., Turner, F.J., and Verhoogen, J.
1958: Metamorphic Reactions and Metamorphic Facies; Geol. Soc. America, Mem.73, reprinted 1962, 259p.

Giblin, P.E.
1968: Notes on Mineral Occurrences, Hornepayne Sheet Map P.476, Geological Compilation Series; Ontario Dept. Mines, MP20, 19p.

Irvine, T.N., and Baragar, W.R.A.
1971: A Guide to the Chemical Classification of Common Volcanic Rocks; Canadian J. Earth Sci., Vol.8, p.523-548.

Jahns, R.H., and Burnham, C.W.
1969: Experimental Studies of Pegmatite Genesis: I) a Model for the Derivation and Crystallization of Granitic Pegmatites; Econ. Geol., Vol.64, No.8, p.843-864.

Maynard, J.E.
1929: Oba Area, Disrict of Algoma; p.114-125 *in* Ontario Dept. Mines, Vol.38, Pt.6, 135p. (published 1930). Accompanied by Map 38c, scale 1 inch to 2 miles.

ODM-GSC
1963a: Mosambik Lake Sheet, Algoma District, Ontario; Ontario Dept. Mines-Geol. Surv. Canada, Aeromagnetic Series, Map 2194G, scale 1:63,360 or 1 inch to 1 mile. Survey flown 1962 to 1963.
1963b: Gourlay Lake Sheet, Algoma District, Ontario; Ontario Dept. Mines-Geol. Surv. Canada, Aeromagnetic Series Map 2195G, scale 1:63:360 or 1 inch to 1 mile, Survey flown 1962 to 1963.
1963c: Oba Lake Sheet, Algoma District, Ontario; Ontario Dept. Mines-Geol. Surv. Canada, Aeromagnetic Series, Map 2208G, scale 1:63,360 or 1 inch to 1 mile. Survey flown 1962 to 1963.
1963d: Kabinakagami Lake, Algoma District, Ontario; Ontario Dept. Mines-Geol. Surv. Canada, Aeromagnetic Series, Map 2209G, scale 1:63,360 or 1 inch to 1 mile. Survey flown 1962 to 1963.

Ontario Dept. Lands and Forests
1963: Ontario Resources Atlas; Operational Branch, 4th Edition, 33p.

Pettijohn, F.J.
1957: Sedimentary Rocks; Harper and Row, Publishers, New York, 718p. Second Edition.

Prest, V.K.
1969: Quaternary Geology; p.675-764 *in* Geology and Economic Minerals of Canada, edited by R.J. Douglas, Geol. Surv. Canada, Econ. Geol. Rept. No.1, 838p. Accompanied by maps.

Siragusa, G.M.
1975 Geology of the Kabinakagami Lake Area, District of Algoma; Ontario Div. Mines OFR5127, 78p., 2 tables, 3 figures, 7 photos (xerox copies). Accompanied by 3 maps.

Tanton, T.L.
1916: Reconnaissance along Canadian Northern Railway between Gogama and Oba, Sudbury and Algoma Districts; Geol. Surv. Canada, Summ. Report, 1916, p.179-182 (published 1917).

Yoder, H.S.
1973: Contemporaneous Basaltic and Rhyolitic Magmas; American Mineralogist, Vol.58, p.153-171.

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